DESIGN ISSUES FOR CONVERTING WEBSITES TO MOBILE SITES AND APPS: A CASE STUDY

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Abstract—**Using mobile devices to access websites has been on the increase in recent years. It has been a challenging task for designers to develop websites that conform to mobile device environment. To address these issues, we reviewed related literature on the development of websites, mobile sites, and mobile apps. We came up with a taxonomy of the major factors that affect the conversion of a website into a mobile site or mobile app. Based on our taxonomy, we used two websites as case studies, addressing design issues during conversion and recommending appropriate GUI components to be used not only in the content of the original website but also in both mobile sites and mobile apps.**

I. Introduction

Web development becomes an industry which is being driven by businesses, e-commerce, marketing as well as both small and large companies. Mobile sites and applications (apps) have emerged as a key challenge for web designers to keep tradeoffs among the agility of the technology, adaptability of the design, and the wide range of mobile devices [1], [2]. In broad terms and in human eyes visualization, mobile sites and apps can look very similar, both of them have some differences and commonalities. However, neither of these comparisons are not an important component of this case study research. Their functionalities, controls, contents, and layouts are a central part of this study. In general, both mobile sites and apps use the same medium landscape such as smart phones and tablets. A mobile site is similar to a standard (desktop/laptop) website. It is accessible over the internet through a browser. However, mobile applications are downloaded and installed on the devices.

Our research question has been stated as follows: what are the factors and the graphical user interface (GUI) components to be considered for converting standard websites to mobile-optimized sites and apps? In order to answer this question and before diving in translating standard websites and developing mobile sites and apps, (1) we investigated design issues pertinent when addressing mobile logistics, and (2) we conducted two case studies at Northwest Missouri State University, the first case is the home coming event site and the second case is the book auction e-commerce site. The two investigations

have been carried out by graduate students as part of their final projects where each website was developed by a team of six graduate students.

Although mobile devices are quite different than standard desktop/laptop computers in terms of many facets including, screen size, hardware constraints, and limited network bandwidth and power. In fact, mobile devices are actually more powerful than standard devices in many aspects and the comparison is irrelevant in the context of this work. The main factors that we consider in this paper for converting, scaling and porting standard desktop/laptop-centric websites to mobile sites and apps are changes in content, controls, functionality and layout [3]. Figure 1 shows the taxonomy of the important factors. The highest classification level identifies broad areas for designing the mobile sites and apps.

The remainder of the paper organized as follows. Section II presents related work. In section III, we present a taxonomy of the major factors to be considered in converting a website to a mobile- optimized site and apps. Section IV, investigates two case studies, home coming event and book auction e-commerce websites, then we present our findings in a comprehensive tabular overview comparing the design issues encountered. We conclude this paper in section V.

II. Related Work

According to Al-Khalifa [4], designing a mobile application requires an entirely different approach than just miniaturizing all the website features. It is the natural progression of the technology to become more convenient and adaptable to circumstances and more responsive to users needs [5], [6]. Maurer *et al.* [7] highlighted the importance of the multi touch technology to overcome the restriction of the screen size, *i.e.,* the data will not be able to fit on the screen. As the number of mobile users are increasing, the companies are much interested in developing mobile version of their websites because mobile versions contain less modules and are most suited for integrating important information. A survey was conducted to identify whether the users prefer standard view
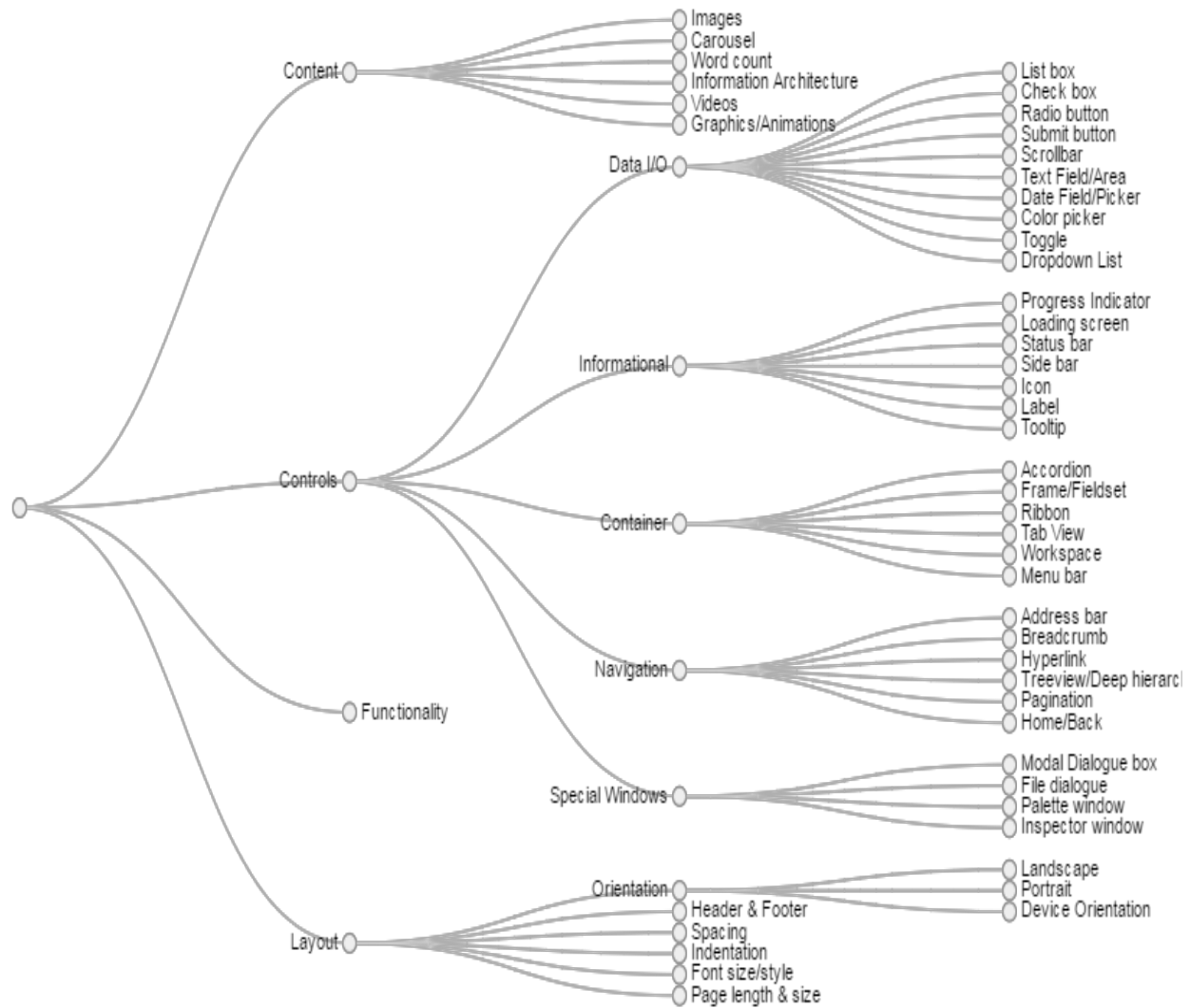
Fig. 1. Taxonomy of UI design factors

websites over mobile version of the website. The survey was conducted to compare two different styles of a website tailored for both mobile devices and desktops with 108 participants over an age group of 20 to 50 years on an average of 26 years, 44% of the participants prefer the mobile version while 25% prefer the desktop version of the site primary for speed and fast access. The choice of the version, either mobile or desktop, has no impact on 30% of the respondents.

There are many design considerations and issues when targeting mobile platforms which combine innovative technologies and guarantee security, quality, and responsiveness in a competitive global environment. A well-developed website should be able to attract users, allow them to finish tasks successfully in less time, and show them information easily [8], [9], [10]. To achieve this post-usability testing is important [8], [11]. Also, designing system architecture help to maintain the system [11], [12] Thus, the skills of the user experience (UX) designer, information architect, user researcher, and visual designer are in high demand.

The main goal of this paper is to identify the design issues faced when converting a website into a mobile site or a mobile application, to make it more competitive, effective, successful and better able to meet the needs of the different stakeholders. However, the literature review does not focus on the functionalities, controls, contents, and layouts for converting websites to mobile sites and apps.

III. TAXONOMY

A review of the literature on the topic of website conversion identifies several steps involved in converting websites to mobile sites and apps. Electronic databases such as ACM Digital Library and Google Scholar are used to search for related scientific and academic peer-reviewed articles using certain keywords.

Figure I shows the taxonomy of user interface design factors. These four categories are again divided into subcategories which represent the actual GUI components used to

TABLE I
COMPARISON OF DESIGN ISSUES AND DESIGN ELEMENTS IN WEBSITES, MOBILE SITES, AND MOBILE APPS.

GUI Component	Website	Mobile Site	Mobile Application
Functionality	All the functionalities are implemented.	Prioritized functionalities are implemented.	Specific functionalities are implemented.
Content			
Image	High quality images are used in websites.	The image size and quality of the image should be reduced.	The image size and quality of the image should be reduced.
Video	High quality videos are used in website.	There is a restriction on the quality and size of the video.	There is a restriction on the quality and size of the video.
Graphics/ Animations	No restriction on the graphical content on the website.	Graphics content should be eliminated/reduced from the mobile website to enhance the performance.	No restriction for offline applications and game applications to enhance the performance.
Carousel	Carousel used as space is not a constraint.	Carousel is not recommended as it consumes space.	Carousel feature is not available.
Word Count	Due to more space in a web page there is no restriction on the word count.	Due to limited space, the word count should be less.	Due to limited space, the word count should be less.
Information architecture	Information architecture is easy on the website.	Information architecture is difficult as content must be prioritized into primary and secondary pages.	Information architecture is difficult as content must be prioritized into primary and secondary pages.
Control			
Date Field	Date pickers are generally used for selecting a date in websites.	Drop downs are generally used for selecting a date in mobile sites.	Date pickers are used for selecting a date in mobile applications.
Tooltip	Tooltip information is displayed when cursor hovers.	On click tooltip. Implemented rarely.	On click tooltip. Implemented rarely.
Ribbon	Ribbons are used in websites to group toolbars into tabs.	Ribbons are not used in mobile sites.	Ribbons are not used in mobile applications.
Breadcrumb	Breadcrumb is generally used to allow the user to keep track of his location on a website.	Depends on the choice of the designer.	Not used in a mobile app.
Pagination	Pagination feature is implemented in websites allowing user to navigate between different pages.	Pagination feature is implemented in mobile sites.	No pagination feature in a mobile app.
Modal dialogue	Modal dialogues are used to display notification or secondary information in a website.	Modal dialogues can be used as per the mobile site requirement.	Modal dialogues can be used as per the mobile application.
File dialogue	File dialogue is feature that allows user to upload files into a website.	No file dialogue windows in mobile site.	File dialogues are not used in mobile applications.
Palette/utility window	Palette window that floats on windows used in websites.	Palette windows are not used in mobile sites.	Palette windows are not used in mobile applications.
Inspector window	This is used in websites that shows information of selected object.	Inspector window is not used in a mobile site.	No inspector window feature in a mobile application.

design the interfaces. The content category can be any form of media, pictures, videos, images and animations, and porting the entire content of a desktop platform to a mobile device would not work. The content [13] changes are sub-divided into images, carousel, word count, information architecture, videos, and graphics/animations. The controls category is further divided into five sub-categories, data input-output, informational, container, navigation, and special windows [14].

There is no further sub-classification for functionality [4]. The layout changes are sub-divided into orientation, header/footer, spacing, indentation, font size/style, and page length and size [15], [16]. Orientation is further divided into landscape, portrait, and device orientation. The rationale for including these categories is to identify the types of GUI components for the feedforward and feedback principles of action life cycle.

TABLE II
COMPARISON OF DESIGN ISSUES AND DESIGN ELEMENTS IN WEBSITES, MOBILE SITES, AND MOBILE APPS.

GUI Component	Website	Mobile Site	Mobile Application
Layout			
Orientation	By default, landscape view is used. Orientation changes as per device.	By default, landscape view is used. Orientation changes as per device.	By default, landscape/portrait view is used. Orientation changes as per device.
Pagination	Pagination feature is implemented in websites.	Pagination feature is implemented in mobile sites.	No pagination feature in a mobile app.
Other Issues			
Fat finger syndrome.	No fat finger syndrome issues.	Users with fat fingers face fat-finger syndrome. To overcome this syndrome, use enlarged user-interface elements.	Users with fat fingers face fat- finger syndrome. To overcome this syndrome, use enlarged user interface elements.
Performance	As the website generally uses broadband connections, the performance of the website is high.	Cut non-critical features to increase the performance of the mobile site.	Cut non-critical features to increase the performance of the mobile application.
Camera and GPS	Depends on the website requirement but the usage is less.	Depends on the mobile website requirement but the usage is less.	Depends on the mobile app requirement but the usage is more.
Ease of access	The website is easy to access.	Requires time to ease of access	Initially, requires the installation of the mobile application. Later easy to access.
Performance	The performance of the website is high when compared to mobile site and mobile application.	The performance of the mobile site is low.	Performance of the application is high when compared to the mobile site.
Search	Searching in the website is more convenient.	Searching is complicated on mobile sites.	Searching is complicated on mobile sites.
Cost	Development cost is low when compared to mobile site and mobile application.	Development cost is more compared to the full website.	Development cost is high for different environments.
Security	All the user inputs should be validated carefully.	All the user inputs should be validated carefully.	All the user inputs should be validated carefully.

IV. CASE STUDY AND CONTRIBUTIONS

The selection criteria we used to select our case studies is based on the size of the application which should be of moderate size. Both websites were developed collaboratively by team members. The websites were designed using paper prototypes so that we can evaluate them while converting the websites to into mobile sites and mobile apps.

We conducted two case studies at Northwest Missouri State University, the first case is the home coming event site and the second case is the book auction e-commerce site. The two investigations have been carried out by graduate students as part of their final projects where each website was developed by a team of six graduate students . Using the taxonomy as a guide, the student teams converted these websites into mobile sites and mobile apps. First, the teams designed paper prototypes and then developed electronic mobile sites and apps. The design issues encountered are shown in Tables I and **??**.

V. CONCLUSION

Throughout our investigation, we found our taxonomy is promising and the most common issues to play predominant factors for converting standard websites to mobile optimized sites and apps are the content, layout, controls, and functionality. For instance, breaking the pages content into categories would simplify the interface, improve speed, and support mobile functionality. Furthermore, pagination feature is important in mobile websites while it is not a feature in mobile apps. Even with some inherent constraints, mobile sites and apps are far ahead in popularity that standard desktop/laptops websites.

REFERENCES

[1] O. M. F. D. Troyer and C. J. Leune, "A user centered design method for web sites," vol. 30, pp. 85–94, 1998.
[2] Z. Evelhoch, "Mobile web site ease of use: An analysis of orbis cascade alliance member web sites," *Journal of Web Librarianship*, vol. 10, pp. 101–123, 2016.

[3] B. Poblete and R. Baeza-Yates, "A content and structure website mining model," in *Proceedings of the 15th international conference on World Wide Web*, 2006, pp. 957–958.

[4] H. S. Al-Khalifa, "Development of mobile government websites: a functional design approach," in *Proceedings of the 13th International Conference on Information Integration and Web-based Applications and Services*, 2011, pp. 455–458.

[5] G. L. Bernstein and S. Klemmer, "Towards responsive retargeting of existing websites," in *Proceedings of the adjunct publication of the 27th annual ACM symposium on User interface software and technology*, 2014, pp. 119–120.

[6] L. A. Leiva, "Restyling website design via touch-based interactions," in *Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services*, 2011, pp. 599–604.

[7] M.-E. Maurer, D. Hausen, A. D. Luca, and H. Hussmann, "Mobile or desktop websites?: Website usage on multitouch devices," in *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries*, 2010, pp. 739–742.

[8] A. Bandi and P. Heeler, "Usability testing: A software engineering perspective," in *Proceedings of the 2013 International Conference on Human Computer Interactions (ICHCI)*, 2013, pp. 1–8.

[9] R. H. Y. Fung, D. K. Chiua, E. H. Koa, K. K. Hob, and P. Loc, "Heuristic usability evaluation of university of hong kong libraries' mobile website," *The Journal of Academic Librarianship*, vol. 42, pp. 581– 594, 2016.

[10] B. Shneiderman, C. Plaisant, M. Cohen, and S. Jacobs, *Designing the User Interface: Strategies for Effective Human-Computer Interaction*. Pearson Education, 2010.

[11] A. Bandi, B. J. Williams, and E. B. Allen, "Empirical evidence on code decay: A systematic mapping study," Mississippi State University, Tech. Rep. 06182013, 2013.

[12] A. Bandi, "Assessing code decay by detecting software architecture violations," Ph.D. dissertation, Mississippi State University, Dec. 2014.

[13] B. Deka, "Data-driven mobile app design," in *Proceedings of the 29th Annual Symposium on User Interface Software and Technology*, 2016, pp. 21–24.

[14] O. Buyukkokten, H. Garcia-Molina, and A. Paepcke, "Accordion summarization for end-game browsing on pdas and cellular phones," in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 2001, pp. 213–220.

[15] A. S. Shirazi, N. Henze, A. Schmidt, and H. Schmauder, "Insights into layout patterns of mobile user interfaces by an automatic analysis of android apps," in *Proceedings of the 5th ACM SIGCHI symposium on Engineering interactive computing systems*, 2013, pp. 275 – 284.

[16] X. Yin and W. S. Lee, "Iusing link analysis to improve layout on mobile devices," in *Proceedings of the 13th international conference on World Wide Web*, 2014, pp. 338 – 344.